Dynamics of Trust in Medical Decision Making: An Experimental Investigation into Underlying Processes

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Background: *Patient trust in medical decision makers is a crucial facilitator of effective health care. Greater patient involvement in decision making requires improved understanding of how such trust is built, maintained, and lost in medical contexts.* ***Objective:*** *The study investigates how trust in clinicians is affected by the 4 main diagnostic outcomes proposed by signal detection theory: true positives, true negatives, false positives, and false negatives. Cognitive appraisals of, and affective reactions to, the decisions were measured to investigate the psychological mechanisms underpinning effects on trust.* ***Design:*** *Members of an Internet research panel (N = 1162) participated in a between-participant experimental study using hypothetical cancer diagnosis scenarios.* ***Results:*** *Overall, correct diagnoses bolstered trust as much as incorrect ones undermined it. Consistent with recent findings in other decision-making domains, trust was not as precarious as generally believed. The influence of decisions and outcomes on trust was mediated through cognitive assessments and affective responses in line with current appraisal theories in psychology. Prior levels of trust in clinicians affected sympathy for doctors, highlighting the role that trust plays in responding to new information.* ***Conclusions:*** *Trust in (hypothetical) clinicians is sensitive to information about their past diagnostic performance. Greater understanding of the cognitive and affective mechanisms by which this occurs may help maintain current high levels of trust. Further research is needed to examine whether findings generalize to real medical decision-making contexts. Clinicians may want to consider the impact their diagnoses have on trust alongside medical and financial considerations.*
Key words: *randomized trial methodology; risk factor evaluation; population-based studies; scale development/validation.* ***(Med Decis Making 2011;31:710–720)***

Surveys suggest that medical professionals are among the most trusted public figures in many societies.[1–4] Trust in the medical profession is important because it promotes willingness to seek advice, reveal information, accept medical recommendations, and adhere to treatment and is related to patient satisfaction.[5,6] Nevertheless, there is also evidence that trust in medical professionals may be in decline,[7,8] possibly because of changes in the nature of health care delivery.[9]

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Such a downward trend may be hard to reverse. Trust, it is said, ''comes on foot but leaves on horseback.''[10] That is, trust may be asymmetric in that it is easier to lose than to gain or regain.[11] Thus, if we are to protect this key bond between patient and clinician, we need to understand more about how trust is eroded and what can be done to halt or even reverse this process. According to Gurmankin and others, ''the importance of identifying effective strategies to establish and maintain trust in the physician-patient relationship cannot be overstated.''[12(p270)]

Although any decline in trust is likely to be multicausal,[9,13,14] the current research focuses on the potential impact of information about a previous high-stakes decision made by a clinician. As patients become more involved in decisions concerning their own health care, they are increasingly using ''performance data ... and clinical outcomes of different providers ... to make a decision as to choice of referral.''[15(p385)] However, we still know very little about how people react to such performance data

and what effect this has on trust across a range of decision outcomes.

Medical diagnoses are often made under conditions of uncertainty. Clinicians rely on a range of factors to assess the probability that a set of symptoms represent an underlying condition. Signal detection theory (SDT) states 4 prototypical outcomes of these kinds of decision: correct acceptance of danger (true positive); correct rejection of danger (true negative); incorrect acceptance of danger (false positive); and incorrect rejection of danger (false negative).[16–18] Under this taxonomy, recommending unnecessary treatment for a noncancerous growth would be a false positive and failing to detect a cancer would be a false negative.

Signal detection theory acknowledges that diagnostic errors are a function of uncertainty and that a ''good decision'' is not necessarily equivalent to an accurate diagnosis. That is, as long as the recommendation was supported by the best available evidence when the diagnosis was made, trust in decision makers such as clinicians should be based upon the quality of their decision making, not on whether their diagnosis turned out to be ultimately correct. As Fischhoff put it, ''in situations where information is limited and indeterminate, occasional surprises—and resulting failures—are inevitable. It is both unfair and self-defeating to castigate decision makers who have erred in fallible systems.''[19(p298)]

Unfortunately, research suggests that both lay and expert judges give too much importance to outcomes relative to appropriate decision making.[20–23] This is referred to as the outcome bias and has been demonstrated in a range of medical contexts.[21,24] To take the example of disease diagnosis, this bias would manifest itself in a greater loss of trust following a false negative than a false positive if the costs of a failure to act (e.g., terminal cancer) were greater than taking unnecessary action (e.g., chemotherapy) even if all the available evidence at the time the decision was made pointed to the situation being safe. Moreover, the higher the costs associated with the mistake, the harsher the decision maker tends to be judged.[22] Extending our cancer diagnosis example, this would mean harsher judgments of a clinician who unnecessarily prescribed chemotherapy with strong side effects.

The aim of the current research was to investigate how trust in clinicians is affected by the 4 decision outcomes outlined by SDT. Although previous research has investigated the impact of false positives (e.g., for mammograms), our work extends this in 3 important ways. First, the main outcomes in earlier research included psychological distress and the likelihood of attending follow-up appointments.[25,26] Although these outcomes are clearly important, a recent review on the long-term effects of false-positive mammograms explicitly called for more research on the effects on trust.[27] In part this call was prompted by the recognition that trust will be important in maintaining good patient–clinician relations in the long term.

Second, our approach goes beyond false positives to examine all 4 SDT outcomes. Traditionally it has been assumed that (any) negative information will undermine trust more than (any) positive information will increase it.[11,28] Recent research, controlling for the extremity[29,30] and type[23,31,32] of positive and negative information, reveals a more complex picture. For instance, findings from other high-stakes decision-making domains such as nuclear power management and the police's response to terrorism suggest that false positives may result in smaller losses in trust than false negatives and can, under certain circumstances, actually increase trust. This makes sense from an outcome bias perspective if the costs of any given false positive are lower than those of any given false negative. Moreover, increases in trust following true positives can be substantial, thus challenging claims that trust is hard to build. Examining these issues in a medical context affords clinicians greater insight into public reactions than a simple correct-incorrect diagnosis dichotomy.

Third, we examine some of the underlying processes behind any changes in trust. Building on appraisal theories of emotion and behavior, we argue that performance information influences trust through an interplay of cognitive and affective processes.[33–35] Specifically, we are interested in how people evaluated different SDT outcomes in cost–benefit terms, what emotions are associated with these evaluations, and how both processes influence stated trust. Medical decision making occurs in an emotive context. Understanding how the public's emotional reactions to events develop could play a key role in aiding service delivery.

The kind of trust we examine is referred to by Calnan and Rowe[5] as ''informed trust.'' In former times, patients tended to trust medical professionals to know best (i.e., ''embodied trust''). Nowadays patients are more empowered and have greater access to information, especially via the Internet. This has resulted in more open and transparent decision making.[36] In keeping with other forms of

trust, informed trust entails (a) a situation involving risk, (b) positive expectations about the other's performance, and (c) preparedness to accept a position of vulnerability based on these positive expectations.[37,38] We also make a distinction between *baseline trust*, reflecting trust in clinicians in general, and *marginal trust*, reflecting how trust in specific actors is affected by new performance information.[31] In the current research, baseline trust is used as a predictor variable and marginal trust is our main dependent variable.

We had 2 main predictions. First, in line with the outcome bias literature we predicted that the more severe the outcomes of correct/incorrect diagnoses the greater trust would be positively/negatively affected.[22] In our scenarios, costs and benefits were manipulated both in terms of decision outcome type (e.g., false positive v. false negative) and the relative severity of both treatment and nontreatment. Crucially, we predicted that positive outcomes (true positives/negatives) would lead to marginal increases in trust and that these increases would be just as substantial as the loss in trust from incorrect diagnoses.

Second, building on appraisal theories, we predicted that both cognitive appraisals of the prior diagnosis and emotional reactions to this appraisal would influence trust in the clinician. Trust is a classic approach-avoidance reaction, and in the current medical decision context we conceptualized the appraisal as an assessment of the costs and benefits of the actual recommendation relative to the alternative. We predicted that the higher the ratio of perceived benefits to costs, the greater the amount of trust. We suspected that emotional reactions would be ambivalent. For instance, following an incorrect diagnosis, an observer may show increased anxiety about the clinician's abilities but also a degree of sympathy or understanding for the clinician in having to make such difficult decisions. We predicted that any anxiety would decrease trust and sympathy would increase it. Moreover, we predicted that the effect of cognitive appraisals on trust would be mediated via these emotional reactions. As far as we are aware, this is the first time this approach has been applied to the issue of trust in decision makers, let alone medical decision makers. Previous research has tended to view trust as either cognitive or affective but rarely examined the interplay between the two.

To test these predictions, we conducted a large experimental study examining trust reactions to hypothetical scenarios concerning a cancer diagnosis case. The experimental approach allowed us to systematically manipulate scenarios in terms of (a) the judged probability of a cancer being present and its likely severity at the diagnosis stage, (b) the length of treatment and severity of potential side effects associated with an intervention, (c) the clinician's initial recommendation to treat or not treat, and (d) subsequent information about the accuracy of the original diagnosis. A complete between-participants design was used so respondents saw only 1 scenario. General levels of trust in clinicians were measured prior to presenting the scenarios, and the impact the scenarios had on marginal trust was measured after the scenarios were presented.

METHOD

Participants

Participants were drawn from a German university-based online panel of members of the general public coordinated by the third author. Of the 4038 invited members, 1162 (40%) responded to the participation request. This response rate is normal for this and other panels.[39] There were 678 (59%) men, the subjects' age ranged from 15 to 81 years ($\bar{x}$ = 37, s = 12), and the majority were German nationals (96%). Fifty-two percent were employed, 26% were apprentices/students, 9% were unemployed, 5% were retired, 4% were homemakers, and 4% responded ''other.'' More than half of the sample (59%) said they or someone they knew well had previously been diagnosed with cancer.

Procedure and Design

The study began by asking participants their general levels of baseline trust in 5 occupations—police, doctors, politicians, business leaders, and lawyers—on scales from 0 (*very little*) to 6 (*very strong*). Thus, our key measure of baseline trust in doctors (referred to here as *pretrust*) was embedded within a more general context and provided us with a measure of trust we could use as a covariate in subsequent analyses investigating trust change.

Next, participants read a fictitious report about a patient who was presenting ambiguous symptoms including a growth that might indicate stomach cancer. Initial investigations were said to have been inconclusive and a specialist had to decide whether to recommend chemotherapy treatment. The situation presenting to doctors was manipulated along 2 dimensions: (a) *risk* (high v. low), where

the high-risk scenario involved an 80% probability of cancer being present and a 6-month life expectancy without treatment and the low-risk scenario involved a 40% probability of cancer being present and a 3-year life expectancy without treatment; and (b) *treatment severity* (high v. low), where high treatment severity involved 6 months of treatment with very unpleasant side effects and the low treatment severity involved 2 months with only uncomfortable side effects. Probabilities of the cancer being present were provided in all scenarios to ensure that any changes in trust could not be accounted for by any discrepancy in the approach to communicating uncertainty.[12]

Following this general introduction, participants read the following (translated from the original German), with text in parentheses and the concluding half of the final sentence reflecting outcome manipulations:

''The doctor spoke emphatically for (against) the treatment at this point and the patient decided to go along with this recommendation. A month later, it became clear that the growth was malignant (benign). The man was therefore correctly (incorrectly) diagnosed and as a result ...'' (a) ''there is a good chance that the cancerous growth will be effectively treated'' (true positive); (b) ''he had to endure several months of unnecessary treatment and side effects'' (false positive); (c) ''he was saved several months of unnecessary treatment and side effects'' (true negative); (d) ''it was probable that the delay in treatment meant he had only a short while to live'' (false negative). Suggesting that the patient would go along with the recommendation is consistent with prior research.[40]

In sum, there was a 2 (risk: high/low) by 2 (treatment severity: high/low) by 2 (recommendation: treat/don't treat) by 2 (cancer present: yes/no) between-participants design with random allocation. The 4 outcome manipulations were checked by asking participants to select a headline from a list reflecting the 4 SDT outcomes (e.g., ''Harmless illness wrongly treated with chemotherapy'': false positive).

Cognitive appraisals of the relative costs and benefits of the chosen option were assessed by asking, ''Compared to the alternative possible decision by the doctor (i.e., to treat [not treat]), how positive or negative do you think the outcomes of their actual decision to not treat [treat] were?'' (–3 = *much more negative*, 0 = *equally negative/positive*, +3 = *much more positive*). Following this, participants were asked the extent to which they felt 6 emotions toward the doctor responsible: compassion, worry, concern, sympathy, anxiety, and admiration (0 = *not at all*, 6 = v*ery strongly*). These were submitted to a principle component analysis with varimax rotation. Two components emerged: *sympathy* (including compassion, sympathy, and admiration, $\alpha = 0.73$; all factor loadings > 0.71; variance explained = 37%) and *anxiety* (including worry, concern, and anxiety, $\alpha = 0.73$; all factor loadings > 0.62; variance explained = 33%).

Trust in the doctor responsible was then measured using 3 items adapted from White and Eiser[31]: (a) How would your trust in the responsible doctor be affected by this event? (–3 = *much less trust*, 0 = *no change*, +3 = *much more trust*); (b) How would you rate the doctor responsible in general following this event? (–3 = v*ery negative*, 0 = *neutral*, +3 = v*ery positive*); and (c) How confident would you be about the appropriateness of future decisions of the doctor responsible? (–3 = *very unconfident*, 0 = *neutral*, +3 = v*ery confident*). These 3 items were highly correlated and combined to form a *marginal trust* scale ($\alpha = 0.96$).

RESULTS

Preliminary Analysis

In terms of the manipulation check, 88% of participants selected the correct headline. Since exclusion of participants who selected an inappropriate headline did not affect results, these were retained. Preliminary analysis found no effects on marginal trust of either gender (Fs < 0.97, Ps > 0.32) or personal familiarity with cancer (Fs < 2.41, Ps $> .12$), so these variables were excluded from further analysis. Because of the large sample size, the significance level was set at $\alpha = 0.001$. Results were analyzed using SPSS version 16.

Descriptions

Descriptions of, and correlations among, the key variables are presented in Table 1. Pretrust in doctors at the start of the study was significantly above the scale's midpoint ($\bar{x} = 3.68$, $t(1159) = 17.27$, $P < 0.001$). Replicating earlier work, doctors were relatively trusted. Overall, marginal trust did not differ significantly from zero ($\bar{x} = 0.09$, $t(1162) = 1.77$). This does not support the notion of trust asymmetry since it seems that overall the effect of positive

Table 1 Means ($\bar{x}$) and Standard Deviations (s) for, and Zero-Order (r) Correlations between, Key Variables

	$\bar{x}$	s	1	2	3	4
Pretrust (1)	3.68	1.35				
Marginal trust (2)	0.09	1.64	0.13[a]			
Appraisal (3)	0.36	2.14	0.02	0.70[a]		
Anxiety (4)	2.24	1.58	–0.05	–0.48[a]	–0.42[a]	
Sympathy (5)	2.79	1.52	0.20[a]	0.65[a]	0.45[a]	–0.16[a]

[a] $p < 0.001$.

events was equal to those of negative events. Pretrust was significantly positively correlated with marginal trust ($r = 0.13$) suggesting that people higher in trust to begin with trusted specific doctors more irrespective of outcomes.

Appraisals of the costs/benefits of the event were, overall, significantly positive ($\bar{x} = 0.36$, $t(1159) = 10.11$, $P < 0.001$), suggesting that people felt that doctors tended to make relatively positive decisions. Both anxiety ($\bar{x} = 2.24$, $t(1149) = 48.03$, $P < 0.001$) and sympathy ($\bar{x} = 2.79$, $t(1151) = 62.51$, $P < 0.001$) were also significantly above zero, suggesting that people were able to hold both emotions simultaneously in line with research into emotional ambivalence. Intriguingly, sympathy was, overall, significantly higher than anxiety, $t(1148) = 7.86$, $P < 0.001$, and although the correlation between them was significantly negative it was not large ($r = –0.16$, $P < 0.001$). Appraisals of costs/benefits were correlated positively with sympathy ($r = 0.45$, $P < 0.001$) and negatively with anxiety ($r = –0.42$, $P < 0.001$). Thus, there were quite strong associations between the cognitive evaluation of costs and benefits and the emotional reactions toward the decision.

Overall, pretrust was positively correlated with sympathy ($r = 0.20$ $P < 0.001$) but not associated with anxiety ($r = –0.05$ $P = 0.12$). Importantly for the hypothesized mediation processes, marginal trust was highly related to appraisals, sympathy, and anxiety ($rs = 0.70, 0.65, –0.48$, $Ps < 0.001$).

Effects of Experimental Manipulations

First, we investigated the effects of experimental condition on marginal trust, appraisals, sympathy, and anxiety using four 2 (risk: high/low) by 2 (treatment severity: high/low) by 2 (recommendation: treat/don't treat) by 2 (cancer presence: yes/no) between-participant analyses of covariance (ANCOVAs) controlling for pretrust. However, across all 4 analyses there were no significant main effects of or interactions involving either risk or treatment severity. In this between-participants design at least, respondents were unaffected by risk or treatment information.

For presentation brevity we therefore reran our analyses without these factors, resulting in four 2 (recommendation: treat/don't treat) by 2 (cancer presence: yes/no) between-participants ANCOVAs controlling for pretrust. Differences in degrees of freedom across analyses are due to missing data. The interaction term between Recommendation and Cancer Presence reflects the difference between correct (true positives/negatives) and incorrect (false positives/negatives) diagnoses (Table 2).

Marginal Trust

There was a main effect of pretrust, $F(1, 1155) = 33.27$, $P < 0.001$. People with higher baseline trust had higher trust in specific doctors. There were also main effects of both cancer presence, $F(1, 1155) = 23.16$, $P < 0.001$, and recommendation, $F(1, 1155) = 110.87$, $P < 0.001$. Marginal trust was higher when cancer was absent ($\bar{x} = 0.28$) than when it was present ($\bar{x} = –0.10$) and following treat v. not treat recommendations ($\bar{x} = 0.49$, $\bar{x} = –0.31$). These main effects were qualified by a significant interaction, $F(1, 1155) = 606.20$, $P < 0.001$. Trust was higher following correct (true positives/negative, $\bar{x} = 1.00$) than following incorrect diagnoses (false positives/negatives, $\bar{x} = –0.83$).

In line with the hypothesis that trust is easier to lose than to gain, the decrease in trust following a false negative ($\bar{x} = –1.41$) was greater than the increase in trust following a true positive ($\bar{x} = 1.21$). However, the increase in trust following a true negative ($\bar{x} = 0.78$) was greater than the decrease resulting from a false positive ($\bar{x} = –0.24$). That is, the trust asymmetry hypothesis (it is easier to lose than to build trust) seemed to hold when

Table 2 Estimated Means ($\bar{x}$) and Standard Errors ($s_{\bar{x}}$) for Marginal Trust, Appraisal, Anxiety, and Sympathy as a Function of Outcome and Controlling for Pretrust

	True Positive		True Negative		False Positive		False Negative	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Marginal trust	1.21	0.08	0.78	0.07	–0.24	0.08	–1.41	0.07
Appraisal	2.24	0.08	1.81	0.08	0.30	0.09	–0.81	0.08
Anxiety	1.64	0.09	1.94	0.09	2.41	0.09	2.98	0.09
Sympathy	3.24	0.08	3.15	0.08	2.89	0.08	1.91	0.08

Controlling for pretrust, $\bar{x} = 3.68$.

the situation really was dangerous (i.e., cancer was present) but not when the situation turned out to be safe (i.e., cancer was absent).

Appraisals

There was no main effect of pretrust, $F(1, 1153) = 1.57$, $P = 0.21$, on how the costs/benefits of the event were perceived. All other findings were similar to marginal trust such that there were significant main effects of recommendation, $F(1, 1153) = 227.62$, $P < 0.001$, cancer present, $F(1, 1153) = 99.40$, $P < 0.001$, and their interaction, $F(1, 1153) = 1089.110$, $P < 0.001$. Appraisals were more positive following treat v. not treat recommendations ($\bar{x} = 1.28$, $\bar{x} = 0.01$), when cancer was absent v. present ($\bar{x} = 1.07$, $\bar{x} = 0.21$), and following correct v. incorrect diagnoses ($\bar{x} = 2.02$, $\bar{x} = –0.76$).

Anxiety

Pretrust was not a significant predictor, $F(1, 1143) = 2.92$, $P = 0.09$. Again, the main effect of recommendation, $F(1, 1143) = 24.46$, $P < 0.001$, and the interaction between recommendation and pretrust, $F(1, 1143) = 103.87$, $P < 0.001$, were significant. Anxiety was lower following treat v. not treat recommendations ($\bar{x} = 2.02$, $\bar{x} = 2.46$) and following correct v. incorrect diagnoses ($\bar{x} = 1.80$, $\bar{x} = 2.70$). Anxiety was not, however, lower when cancer was absent v. present ($\bar{x} = 2.32$, $\bar{x} = 2.17$), $F(1, 1143) = 2.27$, $P = 0.13$.

Sympathy

This time pretrust was a significant predictor, $F(1, 1145) = 54.68$, $P < 0.001$, alongside main effects of recommendation, $F(1, 1145) = 42.12$, $P < 0.001$, cancer presence, $F(1, 1145) = 29.08$, $P < 0.001$, and a significant interaction between them, $F(1, 1145) = 93.96$, $P < 0.001$. People who had higher initial trust were generally more sympathetic toward the doctor regardless of outcome, but nevertheless sympathy was still higher following treat v. not treat recommendations ($\bar{x} = 3.07$, $\bar{x} = 2.52$), when cancer was absent v. present ($\bar{x} = 3.03$, $\bar{x} = 2.57$), and following correct v. incorrect diagnoses ($\bar{x} = 3.19$, $\bar{x} = 2.40$).

Mediation Analysis

To test our predictions that the effects of experimental condition on marginal trust would be mediated by cognitions and emotions, we carried out a series of regression analyses and a structural equation model. In Model 1 (Table 3), we entered the same variables explored in the ANCOVA above: pretrust, recommendation, cancer presence, and the recommendation × cancer presence interaction. All effects were significant and accounted for 40% of the variance in marginal trust. Model 2a adds appraisals ($\beta = 0.54$, $P < 0.001$) and accounts for a further 13% of the variance. Moreover, the strengths of the effects of the experimental variables reduced considerably: recommendation, $\beta s = 0.08$ v. 0.24; cancer presence, $\beta s = –0.00$ v. –0.11; interaction, $\beta s = 0.21$ v. 0.56. In other words, as predicted by appraisal theories, much of the experimental impact was mediated through the evaluation of the relative costs and benefits of the actual v. counterfactual outcomes. Pretrust remained largely unaffected and thus largely unmediated, $\beta s = 0.12$ v. 0.13.

Model 2b adds the emotions of anxiety ($\beta = –0.28$, $P < 0.001$) and sympathy ($\beta = 0.48$, $P < 0.001$) to Model 1 (excluding appraisals) and explained a further 27% of marginal trust variance. Again, at least partial mediation of experimental variables appeared to take place: recommendation, $\beta s = 0.12$ v. 0.24; cancer presence, $\beta s = –0.03$ v. –0.11; interaction, $\beta s = 0.36$ v. 0.56. Moreover, pretrust also appeared to be mediated, $\beta s = 0.02$ v. 0.13. Given

Table 3 Regression Analysis Predicting Marginal Trust in the Specific Doctor Associated with a Correct v. Incorrect Diagnosis Incident

	Model 1	Model 2a	Model 2b	Model 3
Prior attitude				
Pretrust	0.13[a]	0.12[a]	0.02	0.03
Events				
Cancer presence (C)[b]	–0.11[a]	–0.00	–0.03	0.01
Recommendation (R)[c]	0.24[a]	0.08[a]	0.12[a]	0.05
C × R	0.56[a]	0.21[a]	0.36[a]	0.21[a]
Cognitive reactions				
Appraisal	—	0.54[a]	—	0.27[a]
Emotional reactions				
Anxiety	—	—	–0.28[a]	–0.23[a]
Sympathy	—	—	0.48[a]	0.43[a]
R^2 change	—	0.13[a]	0.27[a]	0.17[a]/0.03[a]
R^2	0.40[a]	0.53[a]	0.67[a]	0.70[a]

Note: Values are β.
a. $P < 0.001$.
b. 0 = Cancer not present, 1 = cancer present.
c. 0 = Not treat, 1 = treat.

that pretrust was significantly correlated with sympathy ($r = 0.20$, $P < 0.001$) but not anxiety ($r = -0.05$, $P < 0.12$), we can infer that it is sympathy that was the mediating variable.

Model 3 enters appraisals and both emotions. The amount of marginal trust variance now explained was 70%, a 17% increase from Model 2a and a 3% increase from Model 2b. Importantly, the regression weight for appraisals dropped far more (βs = 0.54 v. 0.24) than those for anxiety (βs = –0.23 v. –0.24) or sympathy (βs = 0.43 v. 0.48). This suggests that the impact of appraisals on marginal trust was mediated through the emotions of anxiety and sympathy rather than appraisals being a product of emotional reactions.

To test this interpretation further we carried out a structural equation analysis. Specifically, we constructed a model based on the outcomes of the regressions in Table 3. Paths were drawn from appraisals, sympathy, anxiety, and the interaction between recommendations and cancer presence to marginal trust since all were significant in Model 3. Since appraisals seemed to mediate the effects of recommendations, cancer, and outcomes on marginal trust (Model 2a), paths were drawn from these 3 variables to appraisals. Since appraisals appeared mediated by sympathy and anxiety (Model 3), paths were drawn from appraisal to the 2 emotions. The residual variances of the 2 emotions were allowed to covary. Since sympathy appeared to mediate the effect of pretrust, we also included a path from pretrust to sympathy. Missing data (pretrust $n = 2$, appraisals $n = 2$, sympathy $n = 11$, anxiety $n = 12$) were replaced with series means to enable the calculation of modification indices.

The model showed very good fit, $\chi^2(14) = 33.53$, $P = 0.002$, CFI = 0.993, RMSEA = 0.035, since *CFI* was greater than 0.95 and *RMSEA* was smaller than 0.06.[41] Modification indices suggested adding a path from ''recommendation'' to ''marginal trust.'' Adding this path did improve the model fit slightly, $\chi^2(13) = 22.72$, $P = 0.045$, CFI = 0.997, RMSEA = 0.025. However, since the path weight (β = 0.06) was considerably smaller than any other path and not significant in regression Model 3, possibly emerging as significant now because of the missing data substitution, we were reluctant to make the model more complex for such little gain. As a result the original model, presented in Figure 1, was retained. Finally, a test of the theoretically alternative model in which experimental condition arouses emotions (sympathy and anxiety) the impact of which on trust is then (partially) mediated by the more cognitive appraisal showed considerably poorer fit, $\chi^2(12) = 797.01$, $P < 0.001$, CFI = 0.724, RMSEA = 0.24, and thus was rejected.

DISCUSSION

Public trust in clinicians and other health professionals is a vital constituent of successful health

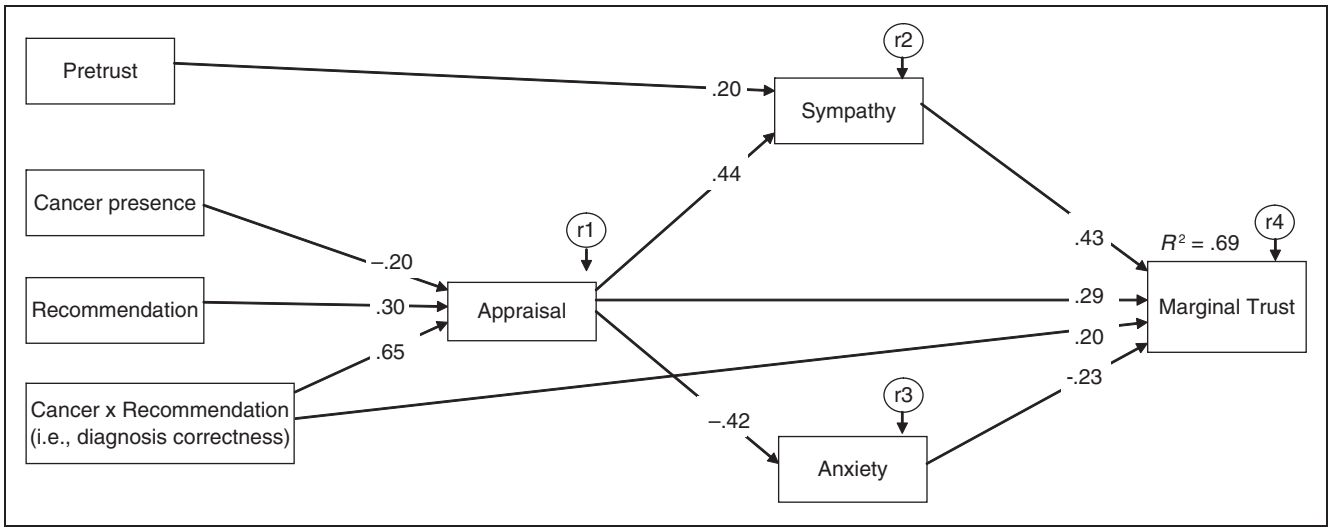

Figure 1 The final path model. Path weights represent standardized regression estimates. All shown paths are significant, $P < 0.001$. *Nonsignificant covariances included in the model among the experimental variables cancer, recommendation, and outcomes and between sympathy and anxiety (all* rs < 0.04*) are not shown.*

care delivery.[5,6,13–16] Suggestions that such trust may be in decline[7,8] demand greater understanding of the mechanisms behind the building and losing of trust in medical contexts. The current research focused on the role that knowledge about a clinician's previous diagnoses has in this process. This issue is becoming increasingly important in modern health care systems with their emphasis on transparency and patient–clinician co–decision making.[9,36] By focusing on (a) how trust is affected by the main diagnostic outcomes as proposed by signal detection theory and (b) the cognitive and affective mechanisms by which any impacts may occur, we provide several novel results.

First, our data do not support the widely cited claim that ''trust is fragile … typically created rather slowly, but … destroyed in an instant by a single mishap or mistake.''[11(p677)] Rather, the average decrease in trust following a diagnostic error was no greater than the average increase in trust following a correct decision. Overall, trust was not more easily lost than gained. Even the most costly error, a false negative that resulted in a lack of necessary treatment and premature death, did not totally undermine trust. Moreover, correct diagnoses appeared to enhance trust, even where this simply meant saying that everything was okay and no treatment was necessary (i.e., true negative). Although possibly surprising, these results replicate recent work in other decision-making contexts.[23,31,32] Clinicians fearful of greater transparency might take some reassurance from these findings.

Second, our results suggest that observers preferred doctors to recommend treatment when uncertain about disease status. In the current context this preference appears to be a rational reflection of the relative payoffs of the 2 options since the costs of a false negative (i.e., premature death) were higher than those of a false positive (i.e., unnecessary treatment). Of course, this does not mean that clinicians should lower the decision threshold for accepting a situation as dangerous just to increase trust; doing so is also likely to increase the rate of false positives. Nonetheless, the results do suggest that there may be a hitherto unaccounted for cost of incorrect (or benefit of correct) diagnoses, namely their effects on trust. In terms of medical outcomes and financial costs, clinicians may be justified in wanting to avoid increasing numbers of false positives. However, if false positives are less detrimental to trust than false negatives and if trust is an important aspect of the patient–clinician relationship, then perhaps decision makers should include the impact of their decisions on trust in their cost–benefit calculations alongside medical and financial considerations.

Third, our findings suggest that trust is not simply a direct product of people's cognitive appraisals. Instead, much of the impact of cognitive appraisals was mediated through both positive (sympathy) and negative (anxiety) emotional reactions. Intriguingly, people seemed to experience both anxiety

and sympathy toward doctors simultaneously, and the 2 emotions played a counterbalancing role in influencing marginal trust. People's reactions were not simply positive or negative but ambivalent and understandably ''human.''

Fourth, there was evidence that trust itself may influence reactions to new performance information. People who had higher levels of trust in doctors in general were more sympathetic and understanding of specific errors than those who had low levels of initial trust. Efforts to maintain trust may therefore be crucial in building public tolerance for inevitable errors. If, by contrast, trust becomes even more eroded, sympathy with further errors may also be undermined, leading to a negative downward spiral. Again, this finding highlights the importance of examining the underlying psychological mechanisms behind trust judgments, especially because prior trust influenced emotional responses directly, unmediated by cognitive appraisals.

One aspect of the study that did not produce predicted results concerned the manipulations of risk and treatment severity. There are at least 3 possible explanations. First, perhaps participants did not take the hypothetical scenarios seriously enough to consider these factors sufficiently. This is unlikely to be the only issue because the main manipulations worked and the appraisal and emotion data suggest extensive engagement. Second, perhaps the context of cancer was so emotive that people no longer considered the details of the actual risk but instead reacted more on their ''feelings.''[42] Again, this seems unlikely because the emotional reactions (a) were not excessively strong and (b) seemed to mediate the effects of the appraisal rather than the other way round. Third, and we think quite plausibly, these data may have been too hard for our sample to interpret. Although a clinician has clear anchors for what an ''80% probability of cancer being present and a 6-month life expectancy without treatment'' might mean relative to other diseases, this is unlikely to be true for most members of the public. Hsee and others[43] refer to this as a lack of intrinsic ''evaluability.'' If our participants had been presented with more than 1 scenario, this may have provided them with the kind of context needed to appreciate the differences in risk and treatment. Previous research suggests, for instance, that whether people evaluate decision makers separately or jointly can have large effects on trust.[44] In short, perhaps in hindsight we should not be too surprised that presenting respondents with complex medical statistics with no reference points did not produce predicted effects.

Despite the many intriguing findings, we also recognize a number of limitations. First, despite the robustness of the statistical model presented, alternative analytic approaches exist. For instance, perhaps sympathy moderates the role of anxiety on trust. Further studies could test these alternatives. Second, appraisal theories of emotion are now well developed, and extensions of our approach could build more explicitly on this literature. For instance, future studies could examine how situational factors such as perceptions of control, responsibility, and legitimacy tend to induce specific emotions. Anger and sadness, for instance, have been relatively widely researched, and both emotions may be relevant in responses to medical decisions.[34,35]

Finally, we remain cautious about the implications for trust in real-world medical decision making. In applied contexts it may be patient trust rather than that of a third-party observer that is important, patient–clinician relationships may already be established, disease states tend to be more graduated and complex than the binary alternatives investigated here, reactions to cancer diagnoses may not be representative of other medical issues, cumulative rather than single diagnostic performance information may be available,[45] and changes in marginal trust may take time as patients ruminate on alternative outcomes. These are all potentially important qualifications. Nonetheless, we believe the systematic, experimental approach adopted here has a number of strengths in terms of controlling for extraneous variables and the ability to examine underlying processes. The challenge for future research is to examine the extent to which our findings are relevant to real medical contexts.

To conclude, trust is a key constituent of effective patient–clinician relations. To date, research has focused on the general characteristics of doctors that enhance or undermine trust such as patience, openness, and warmth. As health services evolve and patients become more active in the decision-making process, it has become necessary to examine how trust is influenced by their knowledge of previous performance and diagnosis histories. Building on the diagnostic framework offered by signal detection theory, the current research suggests a number of implications that might now be examined in real-world decision contexts. First, trust may be enhanced by correct diagnoses. Trust seems to be

not as hard to build as previously thought, and improving the sensitivity of diagnostic tests may be rewarded with public trust. Although perhaps not surprising, it is important not to lose sight of the importance of reducing medical uncertainty and making correct diagnoses in the first place. Second, in some cases there may be a discrepancy between patient preferences for low decision thresholds and clinician preferences for higher decision thresholds due to a focus on individual v. multiple outcomes, respectively. Recognizing this tension and appreciating the rationality in both perspectives may be important in developing effective solutions to this dilemma. Third, emotions are rarely free-floating but instead arise from people's appraisals of a situation and from their prior beliefs. Appreciating the ambivalence of people's emotional reactions to a situation and the grounds on which these are based may help medical decision makers in their efforts to maintain the generally high levels of trust they still command and perhaps even enhance the levels of trust in the future.

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